ZIRCONIA RESTORATIONS

Keys to Successful Placement of Zirconia Restorations

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Abstract: The many positive characteristics of zirconia have made this material a popular choice in indirect dentistry. This article focuses on the placement of zirconia restorations, highlighting proper principles and techniques for successful outcomes. Such issues as sandblasting, the use of primers and cleaning agents, and whether to cement or bond are discussed, and case examples are presented.

Zirconia has seen a dramatic increase in use and popularity in dentistry over the past several years.[1] This restorative material has many positive attributes, including high flexural strength (from five to more than 10 times that of conventional porcelain-fused-to-metal [PFM] restorations[2-4]) and a superior fracture toughness compared to lithium-disilicate and PFM restorations.[5] Zirconia can be bonded or conventionally cemented and, contrary to what many dentists believe, is wear-friendly to the opposing dentition when properly polished.[6-8] Zirconia restorations are compatible with CAD/CAM technology and can be milled full contour to maximize strength or layered with stacked or pressed ceramics for optimal esthetics. (*Note:* The author has written a detailed and in-depth essay on zirconia's physical properties, surface optimization, and cementation options aimed at enhancing clinicians' understanding of the principles and techniques for the placement of zirconia restorations demonstrated in this article,[9] and readers are referred to it. See No. 9 in the Reference list.)

Fig 1. The author suggests clinicians sandblast the intaglio surface of zirconia restorations after try-in and any adjustments, prior to cementation/bonding.

Sandblasting Zirconia Prior to Placement

The author strongly suggests—and this is well supported in the literature[10-13]—that the intaglio surface of zirconia restorations be particle-abraded (sandblasted) prior to placement regardless of what type of conventional or resin-based cement is used. However, certain caveats are in order. First, care should be taken not to use excessive blasting pressures that might cause undue physical damage and/or tetragonal to monolithic phase transformation of the zirconia surface (both of which can reduce physical properties). Also, particle size and type should be considered, because, generally speaking, the larger (more massive) and harder the particle the greater the force it imparts as it hits the target surface. Some studies have shown that traditional high-strength zirconia can be safely and effectively sandblasted with 30 µm to 50 µm aluminous oxide using a blast pressure of 1.5–2.0 bar (approximately 20 psi to 30 psi) from a distance of 2 cm to 3 cm.[13-15] When dealing with translucent zirconia (5 mol % yttria concentration) blasting pressures should be in the lower range (20 psi) to minimize any surface damage that could lead to a reduction in physical properties. The author prefers to sandblast the intaglio surface of zirconia restorations after try-in and any adjustments, just before cementation/bonding (Figure 1).

Zirconia Primers and Zirconia Cleaning Agents

In situations where the dentist wants maximum retention/adhesion between zirconia and tooth tissues (eg, minimally retentive preparations, zirconia winged bridges, etc) some type of bonding protocol using a resin-based cement in conjunction with a zirconia primer is required. The primer can take the form of a separately applied solution that contains a phosphate ester zirconia primer such as 10-MDP (eg, Z-Prime™ Plus, BISCO, bisco.com), or a resin cement can be used that incorporates a zirconia primer directly in its chemical makeup (Figure 2 through Figure 4). If when trying in a zirconia restoration the intaglio surface is contaminated by saliva, phosphate ions from the saliva will bind to and occupy the same reactive sites that zirconia primers require for chemical interactions. This competition for reaction sites greatly decreases the efficacy of zirconia primers, thus it is necessary for these sites to be "freed up" to allow the primer to function optimally. This can be done by sandblasting the restoration after saliva contamination and/or using a strongly alkaline cleaning solution (eg, ZirClean®, BISCO).

Cement or Bond?

In clinical situations where there is a lack of resistance and retention form, and maximum adhesion is required, zirconia restorations should be treated with a zirconia primer and bonded into place with resin cement (Figure 5). Although dentists often prefer dual-cure self-etching self-priming resin cements because no separate bonding agent needs to be placed on the tooth, it should be noted that the highest bond to tooth structure is achieved by using resin


Fig 2.


Fig 3.


Fig 4.

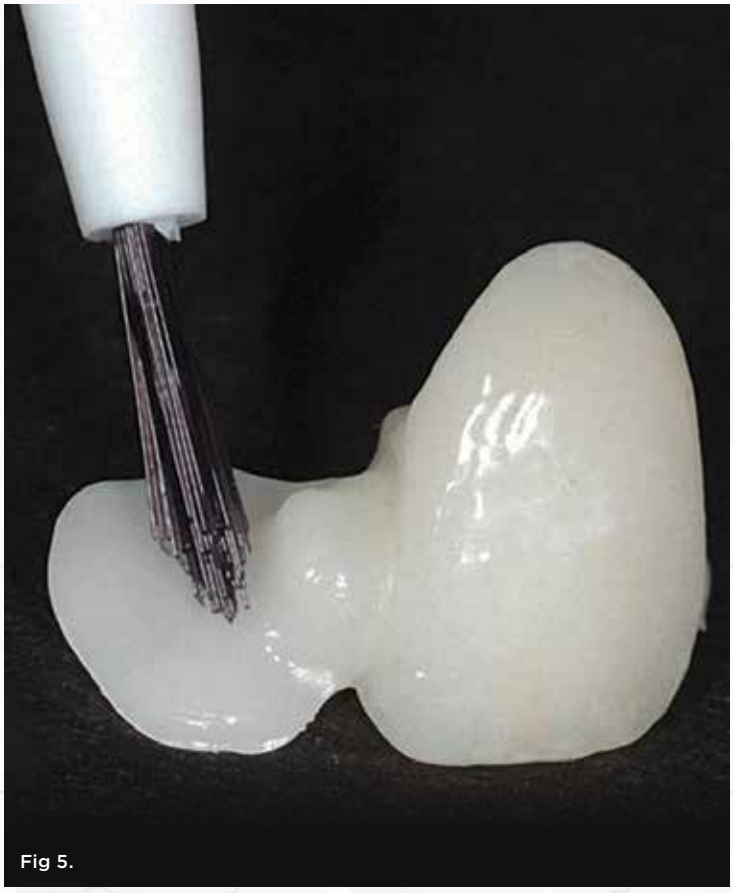
Fig 5.

Fig 2 through Fig 4. To maximize adhesion to zirconia when using a resin cement the intaglio surface should be sandblasted and treated with a zirconia primer (Fig 2). In this case, the primer was dried with a warm-air drier (Fig 3) prior to the placement of a dual-cure resin cement (Fig 4). If the cement already contains a zirconia primer, such as 10-MDP, a separately applied primer may not be necessary.
Fig 5. When there is a lack of resistance and retention form, as in this single-wing zirconia resin-bonded bridge, the intaglio surface may be sandblasted, treated with a zirconia primer (as shown), and bonded into place with resin cement.

cements in conjunction with a separately placed bonding agent.[16-18] Resin-based cements used in conjunction with a bonding agent have a distinct advantage over resin-modified glass ionomers (RMGIs) and other conventional cements with regard to bonding restorations on or in minimally retentive preparations in that their bond to both tooth tissues and zirconia is more durable and predictable.[13,19,20] Moreover, resin-based cements may be advantageous when working with translucent zirconia or zirconia restorations with minimal occlusal thickness, because these cements allow for better stress distribution when loaded, may inhibit crack formation, and generally optimize overall assembly


Fig 6.


Fig 7.


Fig 8.

Fig 6 through Fig 8. Missing tooth No. 25 was replaced with a single-wing (No. 26) high-strength zirconia resin-bonded bridge. The intaglio surface of the wing was sandblasted and treated with zirconia primer to maximize adhesion to the zirconia. To strengthen adhesion to the tooth, enamel and exposed dentin were etched (total-etch) and a universal adhesive was placed prior to the wing being bonded to the lingual of No. 26.


Fig 9.


Fig 10.


Fig 11.


Fig 12.

Fig 9 through Fig 12. When good resistance and retention form are present, zirconia restorations do not require bonding. After sandblasting, they can be placed with ion-releasing cements. Fig 9: Preparations for a three-unit fixed partial denture that demonstrate good resistance and retention form. Fig 10: Monolithic zirconia restoration with ovoid pontic. Fig 11: The case was cemented with a conventional RMGI. Fig 12: The finished case immediate post cementation.

strength.[21] If the preparation(s) has adequate resistance and retention form, then ion-releasing cements that often are easier to use and clean, such as RMGI, are good options.

Case Examples

In Case 1 (Figure 6 through Figure 8) the missing tooth No. 25 was replaced with a single-wing (No. 26) high-strength zirconia resin-bonded bridge. To maximize adhesion to the zirconia the intaglio surface of the wing was sandblasted and treated with a zirconia primer (Z-Prime™ Plus, BISCO). To maximize adhesion to the tooth tissues, enamel and any exposed dentin were etched with phosphoric acid (total-etch), followed by the placement of a universal adhesive (All-Bond Universal®, BISCO). The wing was then bonded to the lingual of No. 26 with a dual-cure resin cement (Duo-Link Universal™, BISCO).

Case 2 (Figure 9 through Figure 12) is an example of a situation where there was good resistance and retention form, and retention was not an issue. In such cases, zirconia restorations do not have to be bonded in, but, after sandblasting, can be placed with ion-releasing cements such as RMGI or TheraCem® (BISCO), which generally are easier to clean and work with.

Conclusion

A common misconception is that dentists cannot bond to zirconia. The fact is zirconia surfaces can be bonded to very predictably and durably using a combination of sandblasting, a phosphate ester primer such as 10-MDP, and an appropriate resin-based cement.[9] Proper management of both the zirconia substrate and tooth tissues is crucial for predictable and durable clinical outcomes. As a general rule the intaglio surface of all zirconia restorations should be particle-abraded (sandblasted) and a zirconia primer placed (typically, a phosphate ester like 10-MDP). However, this is not true in every situation, and the use of a separate zirconia primer is contraindicated or unnecessary with some materials. In this regard, manufacturer instructions and recommendations should be followed precisely for best results. It is incumbent on all clinicians to familiarize themselves with optimal cementation options and protocols when placing zirconia restorations.

DISCLOSURE

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